Retrieval analysis of 240 metal-on-metal hip components: Comparison between modular total hip replacement and hip resurfacing arthroplasty

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INTRODUCTION:

There has been growing concern regarding the incidence of painful soft tissue masses in patients with metal-on-metal (MOM) hip arthroplasty. In hip resurfacing, increased component wear rates and blood metal ion levels have been associated with these soft tissue reactions. It is therefore important to quantify wear in all types of MOM hip and compare this with hip resurfacing.

There are four published retrieval studies of current generation MOM hip designs, reporting wear rates for only 63 hip couples (head and cup). Wear rate has been reported for only 1 current generation modular femoral head component and no acetabular component.

The primary aim of this study was to quantify wear in a large series of current generation explanted large diameter modular MOM THRs and compare this to hip resurfacing. Additionally, we sought to compare blood metal ions between the two types of MOM hip and investigate the roles of edge loading and component position, which have both linked to increased wear in MOM hip resurfacing.

METHODS:

Components. This was an IRB approved study. A consecutive series of 60 failed large diameter modular THRs were matched to a group of 60 failed large diameter hip resurfacings for gender and head size. All components had been implanted for over 12 months and consisted of a large diameter head (≥ 38mm) and a resurfacing mono-block cup. Imaging and blood metal ion data was analysed retrospectively.

Linear wear measurement. Firstly, all components were visually inspected for any signs of in vivo performance.

Wear measurements were made using a Taylor Hobson Talyrond 365 roundness machine and in total 3 separate measurements are taken of the head and cup in order to quantify the maximum linear wear depth and separate this from any possible form error. These measurements provide the depth, location and extent of the wear patch, and this enabled us to calculate the maximum linear wear rate (μm/year) and to identify whether the acetabular components were edge worn.

Statistical analysis. A non-parametric approach was used.

RESULTS:

Linear wear rate and blood metal ion levels. Tables 1 and 2 show that there was no significant difference between the modular THR and hip resurfacing groups for linear wear rate and blood metal ions respectively. P values were calculated using Mann Whitney U test.

Table 1. Linear wear rates (μm/year). Values are median (range)

<table>
<thead>
<tr>
<th></th>
<th>Modular THR</th>
<th>Hip Resurfacing</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cup wear rate</td>
<td>0.0-119.2</td>
<td>4.7 (0.0-173.8)</td>
<td>0.466</td>
</tr>
<tr>
<td>Head wear rate</td>
<td>0.0-51.3</td>
<td>3.5 (0.0-84.7)</td>
<td>0.087</td>
</tr>
</tbody>
</table>

Table 2. Whole blood metal ion levels (ppb). Values are median (range).

<table>
<thead>
<tr>
<th></th>
<th>Modular THR</th>
<th>Hip Resurfacing</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobalt</td>
<td>8.6 (0.5-91.0)</td>
<td>11.1 (0.9-167.0)</td>
<td>0.565</td>
</tr>
<tr>
<td>Chromium</td>
<td>4.2 (0.1-58.2)</td>
<td>6.5 (0.4-183.0)</td>
<td>0.054</td>
</tr>
</tbody>
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Visual inspection. Inspection of the bearing surfaces commonly revealed fine scratching and in some cases the wear patch was visible. In the resurfacing group there were 3 cases of impingement (Figure 1).

DISCUSSION and CONCLUSIONS:

From the largest study of explanted current generation MOM hips we report new and clinically important findings regarding the in vivo performance of current generation large diameter MOM hip arthroplasty.

1) No difference in wear rate between explanted modular THR and hip resurfacing. This suggests that the clinical problems associated with high wear in hip resurfacing are likely to occur in all large diameter MOM arthroplasty. This was supported by the blood metal ion analysis.

2) Edge loading is an important mechanism of wear and is associated with steep cup inclination. Despite this, we have also shown for both modular and resurfacing arthroplasty that edge loading occurs throughout the entire range of cup inclination. This does not support previous suggestion that implanting at ≤ 40° inclination could reduce wear rates. We suggest that excessive version is likely to be an important risk factor for edge loading, with several examples of edge worn cups implanted with acceptable inclination but excessive version.

3) Edge loading occurs more commonly in hip resurfacing. A higher proportion of resurfacings with either insufficient cup inclination or version were edge worn compared to modular THR. We suggest that neck retention in hip resurfacing increases the risk of anterior impingement at these extremes of cup position. Impingement causes subluxation of the femoral component and subsequent edge loading.

Figure 1. The arrow, left, indicates an area of damage to the femoral neck consistent with cup rim to neck impingement, which is highlighted by the circle, right.

Figure 2. Cup linear wear rate plotted against cup inclination angle.